(12) UK Patent Application (19) GB (11) 2 169 402 A

(43) Application published 9 Jul 1986

(21) Application No 8531233

(22) Date of filing 19 Dec 1985

(30) Priority data
(31) 8432099 (32) 19 Dec 1984 (33) GB

(51) INT CL⁴
G01N 21/89

(52) Domestic classification (Edition H):
G1A A9 C3 C4 C8 D10 G11 G1 G2 G5 G6 MB R6 R7 S10 S12 T15 T25 T3 T8
U1S 2030 G1A

(56) Documents cited
GB A 2081891 GB 0783524 EP A1 0014464
GB A 2015724 EPA2 0037669 EP A1 0003068
GB 1362320

(58) Field of search
G1A
Selected US specifications from IPC sub-class G01B

(71) Applicant
J H Fenner & Co Limited (United Kingdom),
Marfleet, Hull, North Humberside HU9 5RA

(72) Inventor
Ashley David Derrick

(74) Agent and/or Address for Service
W P Thompson & Co,
Seaton Buildings, Jameson Street, Hull, North Humberside HU1 3JS

(54) A method and an apparatus for detecting tears in a conveyor belt

(57) An apparatus for and a method of detecting tears in a conveyor belt (1), wherein a light emitter (6) is positioned facing one surface of the conveyor belt (1) and a light receiver (7) is positioned in alignment with the light emitter (6) and facing the opposite surface of the belt (1). Where there is no tear in the belt, light from the emitter (6) will be occluded from the receiver (7). However, where there is a tear in the belt (1) light from the emitter (6) will pass from the emitter (6) to the receiver (7) on the passage of a tear or gap past the light beam. If the emitter is pulsed the width of the tear or gap may be determined from the number of pulses counted by counter 11 and the belt speed.

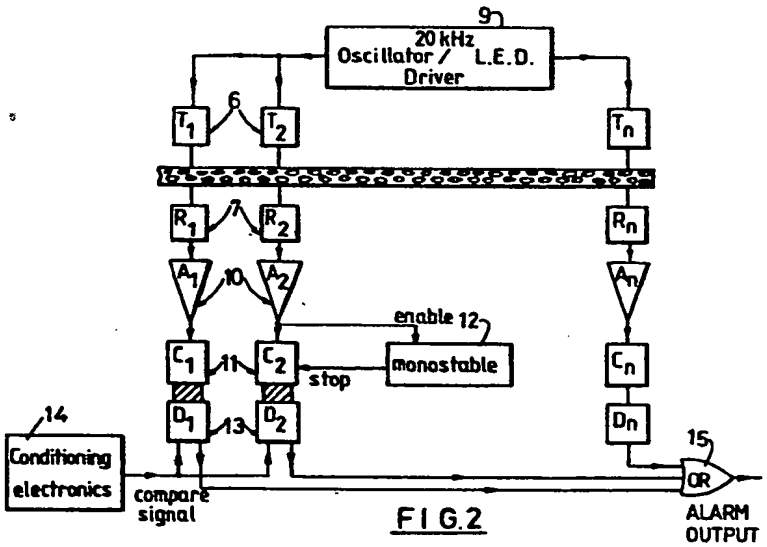

FIG.2

GB 2 169 402 A

The drawings originally filed were informal and the print here reproduced is taken from later filed formal copies.

This print embodies corrections made under Section 117(1) of the Patents Act 1977.

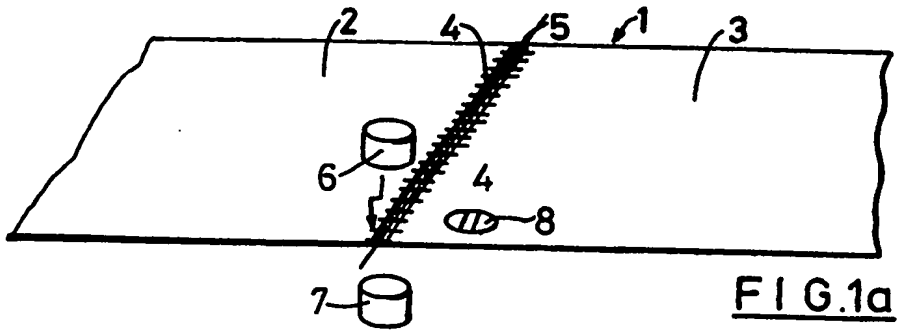

FIG.1a

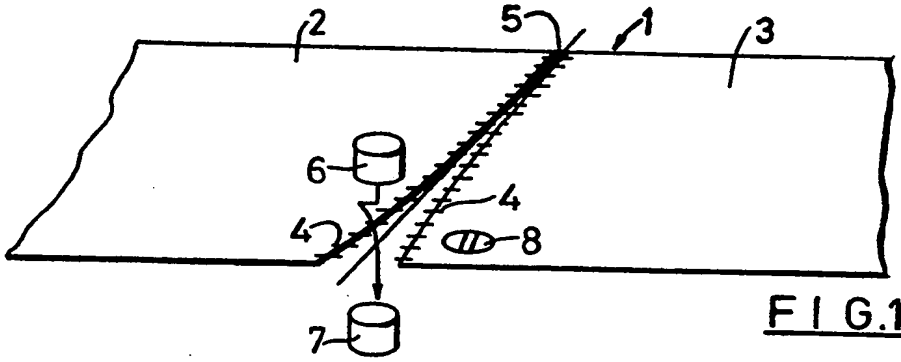

FIG.1b

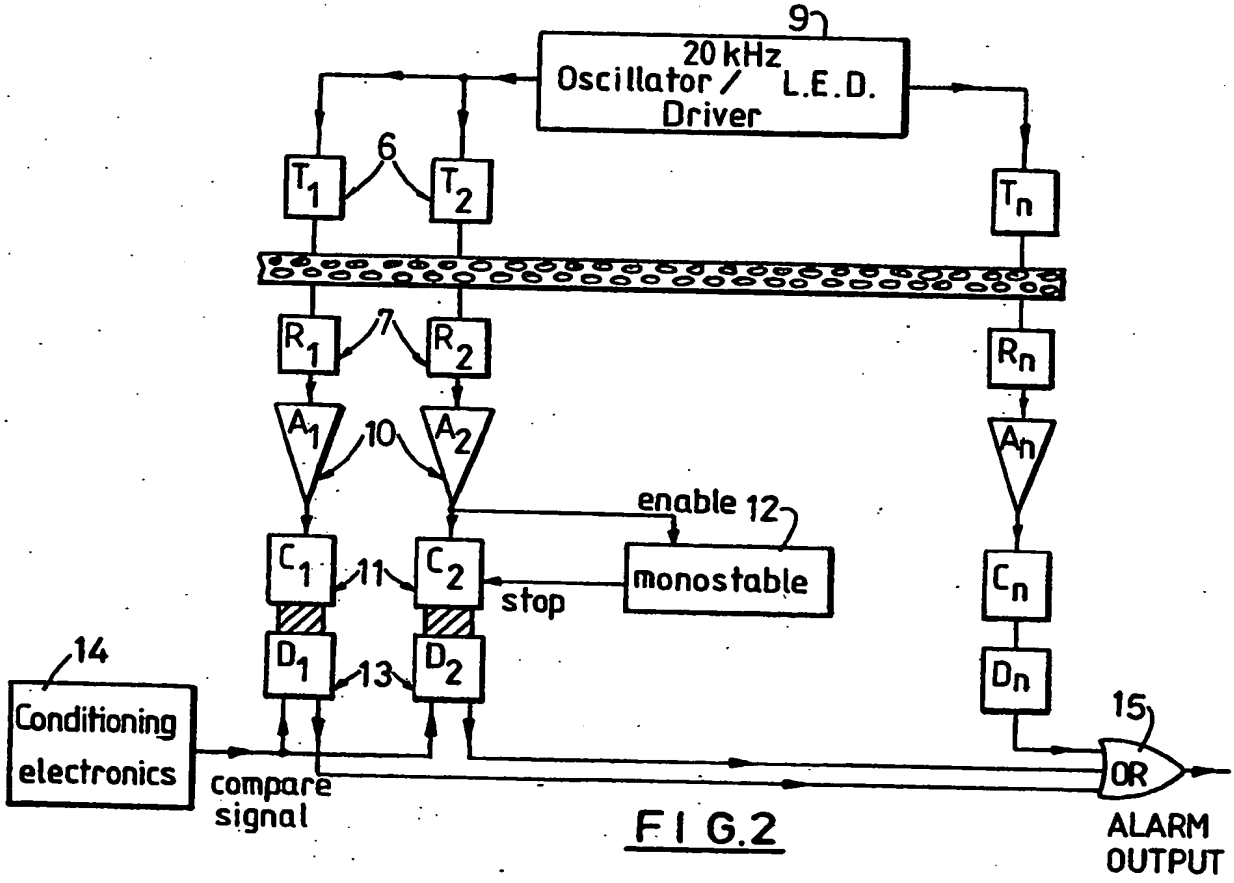

FIG.2

SPECIFICATION

A method and an apparatus for detecting tears in a conveyor belt

The present invention relates to an apparatus for, and a method of detecting tears in a conveyor belt, and has particular application in providing an early indication of failure of a fastener type joint in a conveyor belt.

Tears in conveyor belts lead to belt breakage which can cause extensive damage to the main conveyor structure, lost production and personal injury to anyone close to the conveyor. Visual inspection of the conveyor belt at periodic intervals for tears is a tedious process and is costly in terms of man hours when long conveyor runs are employed.

Conveyor belts are usually formed by fastening together several individual sections of belting. The adjacent ends of neighbouring sections of belt are fastened together by means of loops fixed to the end of each section of belt, which loops are interleaved with one another such that a wire passing through them fastens the belt together. Failure of this type of joint is usually preceded by combing of the loops through the belt such that a gap develops between the adjacent ends. It is an object of the present invention to provide an apparatus for, and a method of detecting tears in a conveyor belt which obviates the need for periodic manual inspection of the belt.

According to a first aspect of the present invention there is provided apparatus for detecting tears or fastener joint failure in a conveyor belt, comprising a light emitter positioned, in use, facing one surface of the conveyor belt, and a light receiver positioned in alignment with the light emitter and facing the opposite surface of the belt, such that light from the emitter is occluded from the receiver by the belt when tears or joint failures are absent.

Preferably, the light emitter comprises an infrared light source. Conveniently, the infra-red light source is pulsed to enable the size of the tear in the belt to be determined. In this respect, it is preferable to use a pulse frequency of not less than 10 kilohertz and higher frequencies of, for example, 20 kilohertz may be employed.

A recognition marker may be employed to identify a particular reference point on the belt so that the position of tears in the belt can b calculated. Knowing the velocity of the belt and the elapsed time between the reference and the tear, the position of the tear on the belt can be identified. Conveniently, the recognition marker takes the form of a metalic disk which can be detected using an inductive sensor.

Preferably, at least two light mitters and receivers are pr vid d across the width of the belt, with one light emitter and receiver being positioned adjacent each edge of the belt where tearing is most likely to commence. Where further light emitters and receivers are provided at least one of these is preferably positioned in alignment with the transverse centre line of the belt.

According to a second aspect of the present invention there is provided a method of detecting tears or fastener joint failure in a conveyor belt comprising positioning a light emitter and a light receiver in alignment on opposite sides of the belt to be monitored so that the belt is positioned to intercept the light beam and occlude light from the receiver, and identify the tears in the belt or the gaps formed by fastener joint failure by moving the belt through the light beam so that light passes from the emitter to the receiver on the passage of a tear or gap past the light beam.

Preferably, the light beam is pulsed so that the size of the tear or gap can be calculated. In this respect, the number of pulses received by the light receiver can be used to determine the period the gap takes to pass between the ligh emitter and receiver. Knowing the speed of the belt past the light emitter and receiver it is then possible to calculate the size of the gap or tear.

An embodiment of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figs. 1(a) and 1(b) illustrate the principle of operation of the apparatus and the method of the present invention with reference to a secure fastener and a fastener about to break, respectively; and

Fig. 2 shows a part schematic and part block circuit diagram of a conveyor monitoring apparatus embodying the present invention.

Referring to Fig. 1(a) there is shown a portion of a conveyor belt 1 comprising two adjacent sections of belting 2, 3. The adjacent ends of the two sections 2, 3 are fastened together by means of several loops provided at the end of each section of belting 2, 3 which loops 4 are interleaved with one another such that a wire 5 passing through them fastens the sections 2, 3 together. As will be apparent from Fig. 1(b), failure of this type of joint is usually preceded by combing of the loops 4 through the ends of the sections 2, 3 such that a gap develops therebetween. The gap usually starts at the edges of the b lt 1.

Positioned above the belt 1 is a short-wavelength pulsed infra-red mitting source 6 and positioned below the belt 1 is an infra-red receiver 7 spectrally matched to the emitter. For the sake of convenience, the emitter 6 and the receiver 7 are positioned on opposite sides of the bottom or return run of the conveyor belt 1. The receiver 7 is located immediately opposit the emitter s that in n rmal

circumstances the belt will occlude the infra-red light from the receiver. However, in the event that a gap develops between the sections of belting 2, 3 infra-red light from the emitter will pass through the gap to the receiver each time the gap passes therebetween. Thus, a signal is generated by the receiver 7 indicating the presence of a gap.

As indicated previously, the light from the emitter 6 is pulsed at a known frequency. By counting the number of pulses received by the receiver 7 it is possible to determine the exact length of time taken for the gap to pass between the emitter 6 and the receiver 7. If the belt velocity is then determined it is possible to calculate the exact size of the gap. Using some sort of comparator it is then possible to have an alarm triggered or other warning devices operated when a predetermined maximum absolute value of gap exists or when a predetermined maximum rate of increase in the size of the gap is noted on successive revolutions of the belt 1.

In order to facilitate identification of the exact spot on the belt 1 where a tear or gap is sensed a metal marker 8 may be inserted into the belt or attached thereto. The metal marker 8 can be detected by, for example, an inductive sensor and provides a reference point on the belt 1. Moreover, where the speed of the belt 1 is known the time taken for the belt 1 to move from the marker 8 to an identified gap can be used to calculate the exact position of the gap on the belt 1.

Referring now to Fig. 2 there is shown a part schematic and part block diagram of a conveyor belt monitoring apparatus. The apparatus comprises "n" emitter 6 and receiver 7 combinations spaced along the bottom or return run of a conveyor belt 1. The emitters 6 are driven by a driver 9 at a frequency of 20 kilohertz. Each of the receivers 7 is connected to a signal conditioning amplifier 10 which is in turn connected to a counter 11. Each counter 11 is turned on and off by an enabling monostable 12. The output of each counter 11 is connected to a digital comparator 13 which compares the value in the counter 11 with a predetermined absolute maximum value provided by conditioning electronic circuitry 14. The output of each comparator 13 is connected via a logical OR circuit 15 to an alarm circuit not shown.

In the event that a tear occurs in the belt 1, then pulsed light from the emitters 6 will be received at the receivers 7. The resultant pulse train utput from the receivers 7 is processed by the amplifiers 10 and the number of pulses in the pulse train is counted in counter 11. The number of pulses c unted by the counter 11 will be determined by the size of the gap in the belt 1 and the speed at which the belt passes the emitter 6 and receiver 7 combination. Where the speed f the belt 1 is known, the count in the counter 11 can therefore be used to provide an indication as to the size of the gap. To this end the output of the counter 1 is compared with a predetermined value provided by the conditioning electronics 14 and if it exceeds the predetermined value then the size of the gap is such that an alarm condition exists.

Any convenient means may be employed to determine the velocity of the belt. For example, a tachometer may be provided in one of the idler rollers of the conveyor. A typical velocity for the belt 1 will be 1 meter per second and with a pulse frequency greater than 10 kilohertz this will enable very small gaps to be detected.

Of course, where it is only desired to identify the position of the gap the use of a pulsed infra-red light emitter is not essential since the pulse feature is not required. To avoid spurious readings from ambient light sources it is preferred to use infra-red pulsed at a set frequency or another discrete wavelength or colour of light.

CLAIMS

1. Apparatus for detecting tears or fastener joint failure in a conveyor belt, comprising a light emitter positioned, in use, facing one surface of the conveyor belt, and a light receiver positioned in alignment with the light emitter and facing the opposite surface of the belt, such that light from the emitter occluded from the receiver by the belt when tears or joint failures are absent.

2. Apparatus according to claim 1, characterised in that the light emitter comprises an infra-red light source.

3. Apparatus according to claim 2, characterised in that the infra-red light source is pulsed, counter means are associated with the light receiver to count the number of pulses received and means are provided to determine the velocity of the conveyor belt, thereby allowing the size of a tear or gap in the belt to be calculated.

4. Apparatus according to claim 2 or 3, characterised in that the pulse frequency is not less than 10 kilohertz.

5. Apparatus according to any preceding claim, characterised in that a recognition marker is provided in the belt and detector means are provided for detecting the recognition marker.

6. Apparatus according to claim 5, characterised in that the recognition marker comprises a metal tag and the detector means comprises an inductive sesnor.

7. Apparatus according to any preceding claim, characteris d in that a light emitter and rec iv r combination are provided adjacent each edge of the belt where tearing is most likely to commence.

8. Apparatus according to claim 7 charaterised in that a light emitter and receiver combination is positioned in alignment with the

transverse centre line of the belt.

9. A method of detecting tears or fastener joint failures in a conveyor belt comprising positioning a light emitter and a light receiver in alignment on opposite sides of the belt to be monitored so that the belt is positioned to intercept the light beam and occlude light from the receiver, and identify the tears in the belt or the gaps formed by fastener joint failure by moving the belt through the light beam so that light passes from the emitter to the receiver on the passage of a tear or gap past the light beam.

10. A method according to claim 9, characterised in that the light beam is pulsed, the number of pulses received by the receiver is counted and the velocity of the conveyor belt is determined, thereby allowing the size of a tear or gap in the conveyor belt to be calculated.

11. A method according to claim 9 or 10, characterised in that a recognition marker is employed to identify a particular reference point on the belt so that the position of a tear or gap in the belt can be calculated.

12. A method according to claim 11, characterised in that the velocity of the belt is determined and the position of a tear or gap in the belt relative to the recognition marker is calculated from the elapsed time between a recognition marker being detected and a tear or gap on the belt being detected.

13. Apparatus for detecting tears or fastener joint failure in a conveyor belt substantially as hereinbefore described with reference to the accompanying drawings.

14. A method for detecting tears or fastener joint failure in a conveyor belt substantially as hereinbefore described with reference to the accompanying drawings.

Printed in the United Kingdom for
Her Majesty's Stationery Office, Dd 8818935, 1986, 4235.
Published at The Patent Office, 25 Southampton Buildings,
London, WC2A 1AY, from which copies may be obtained.